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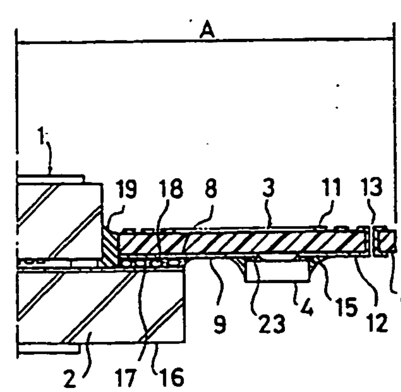
(54) **STRUCTURE AND METHOD FOR MOUNTING SEMICONDUCTOR DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE.**

(57) A semiconductor device (4) is mounted on one surface of a circuit board (3). The input wiring (12), output wiring (9), and either the input or output terminals (11 or 8) of the device (4) are formed on the same surface. When either the input or output terminals (11 or 8) are formed on the device mounting surface of the board (3), the other terminals (8 or 11) are formed on the other surface of the board (3). The terminals (8 or 11) are interlayer-connected to their corresponding input or output wiring (12 or 9) through via holes. In order to interconnect adjacent semiconductor devices on the same circuit board or semiconductor devices on adjacent circuit boards, input bus wiring (14) connected to their input terminals is provided. When the semiconductor devices are mounted on a liquid crystal display device, the output terminals (8) are connected to the corresponding LCD terminals (17) of LCD cells (2) through an anisotropic conductive film (18). Adjacent circuit boards are interconnected by connecting their input terminals to each other through wires (21), FPC (22), etc.

Fig. 3



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TECHNICAL FIELD

This invention relates to structure and method for a mounting semiconductor devices and more particularly to structure and method suitable for mounting semiconductor devices in an electronic apparatus such as a liquid crystal display by using a circuit board. Further, this invention relates to a liquid crystal display in which semiconductor devices for driving the liquid crystal is mounted by using such structure and method.

BACKGROUND ART

Previously, there have been known methods for mounting semiconductor devices in an electronic apparatus, for example, what is called a TAB (Tape Automated Bonding) method for connecting tape carrier packages, on each of which semiconductor devices are mounted, at a time collectively by using TAB technology and a COG (Chip-on-Glass) method for directly connecting semiconductor devices to interconnecting wires or lines, the pattern of which is formed on a glass substrate.

In the case of a liquid crystal display, it is usual to connect a driving semiconductor chip to the peripheral part of the panel of the liquid crystal display, which consists of X-electrodes and Y-electrodes of a matrix structure, by using the TAB method. However, in this case, input and output lines of semiconductor devices are formed on the same surface of a TAB package. Moreover, each TAB package is mounted on the outside of the crystal liquid panel. Thus, the mounting area becomes very large. Further, what is called a large frame portion, namely, what is called a large dead area is formed in the peripheral part of the liquid crystal display portion. Consequently, the liquid crystal display has a problem in that the entire liquid crystal display is large in size and relatively, the displaying area becomes small.

Furthermore, a separate driving circuit board provided with an input bus line for supplying an input signal and electric power to the semiconductor devices of each TAB package is necessary. Thus, the liquid crystal display has a problem in that the dead area is further expanded and the cost increases.

Moreover, in the case of directly mounting the driving semiconductor devices on the surface of the liquid crystal panel by performing the COG method, the patterns of the input and output lines or the like are formed on the surface of the peripheral part of the liquid crystal are formed. As a result, the mounting area of the liquid crystal panel becomes large. Similarly as in the case of employing the TAB method, the dead area becomes very large. Additionally, the liquid crystal panel is furnished with the input and output lines and the input bus line crosswise on the same surface. Consequently, the liquid crystal display has a problem in that the manufacturing cost becomes very high.

Therefore, the applicant of the instant application proposed a structure in which a liquid crystal driving LSI is mounted in a liquid crystal display through a multilayer circuit board, as described in the specification of Japanese Patent Application No. 5-2235223/1993. As illustrated in FIGS. 26 and 27, in the case of this laminated circuit board 55, input lines 57, output lines 58 and input terminals 59 are formed on a surface thereof, to a predetermined position at which a driving LSI 56 is connected. Further, output terminals 62 for connection to a connecting terminal 61 of a liquid crystal panel 60 is formed on the back surface thereof. Moreover, input bus lines 63 or the like are provided in intermediate layers. Interlayer connections are established between the output lines and terminals and between the input lines and terminals through via holes 64.

Thereby, a driving circuit board to be connected to the TAB board becomes unnecessary. Consequently, the mounting area becomes small. Moreover, the entire liquid crystal display can be small-sized and thinned. Furthermore, the reliability can be improved by reducing the number of connection points.

This laminated circuit board, however, has the following problems. Namely, the manufacturing cost becomes high because interlayer connections are made among a large number of output lines and terminals, usually, among output lines and terminals of 80 to hundreds per semiconductor device through via holes, and that the mounting area of the circuit board becomes large because a large number of via holes are bored therein. Further, owing to the fact that the multilayer structure has at least three layers, the manufacturing process becomes complex and the manufacturing cost is increased. Moreover, the liquid crystal display equipped with the LSI can not be sufficiently thinned. Furthermore, because of the difficulty in processing, it is difficult to realize a fine pitch of the output lines, which is no more than, for example, 150 µm. Therefore, there has been a fear that the laminated circuit board can not sufficiently meet the demand for the downsizing of electronic equipment.

Accordingly, an object of the present invention is to provide a structure and a method for mounting semiconductor devices, by which interlayer connections established through via holes are partly or completely avoided on a circuit board, on which the semiconductor devices are mounted, to reduce the mounting area, and by which intermediate conductive layers for furnishing the circuit board with

input and output lines and bus lines are eliminated from the circuit board to decrease the thickness thereof, whereby the demand for compact equipment or for the downsizing of the equipment can be met, and the manufacturing process can be simplified and the manufacturing cost can be reduced.

Further, another object of the present invention is to provide a liquid crystal display in which the frame area is minimized, namely, the area of the dead area of the liquid crystal panel thereof, when mounting a driving LSI thereto, whereby the displaying area thereof can be enlarged and the size and thickness of the display can be reduced by responding to the demand for the downsizing of the equipment.

DISCLOSURE OF THE INVENTION

In accordance with the present invention, there is provided a structure for mounting semiconductor devices in an electronic apparatus, characterized by comprising a plurality of circuit boards being respectively provided with semiconductor devices and having two sets of input lines and a set of output lines, two sets of input terminals respectively connected to the sets of the input lines, a set of output terminals connected to the set of the output lines, and an input bus line interconnecting the sets of the input terminals, and characterized in that the output terminal of each of the circuit boards is connected to a corresponding terminal of the electronic apparatus and that each of the circuit boards is connected with another adjoining one of the circuit boards by electrically connecting each of the sets of the input terminals of each of the circuit board to one of the sets of the input terminals of the adjoining one of the circuit boards.

In accordance with a first embodiment of the present invention, in each of the circuit boards, the output lines, the output terminals and the input lines are formed on the surface on which the semiconductor device is mounted. The input terminals and the input bus lines are formed on the surface opposite to the semiconductor-device mounting surface. Moreover, a via hole for connecting each of the input terminals to a corresponding one of the input lines is bored in each of the circuit boards. Furthermore, a bus line path for connecting the semiconductor devices of the adjoining circuit boards is constituted by the input bus line.

In this case, in addition to the input bus line, a second input bus line is formed in the semiconductor-device mounting surface by connecting the two sets of the input lines with each other through the terminal of the semiconductor device. Further, in the case where the inside of the semiconductor device is divided into a plurality of blocks, the same signal can be supplied to each of the blocks through the two sets of the input lines and the input terminals, separately. Moreover, there may be provided a cascade connection by which an output of the semiconductor device corresponding to the signal input from one of the sets of the input lines is sent to the semiconductor device of another circuit board through the other of the sets of the input lines and is then output from the latter semiconductor. Further, such connections among the semiconductors, the two sets of the input terminals and the input terminals can be suitably combined with each other, if necessary.

Moreover, in accordance with a second embodiment of the present invention, in each of the circuit boards, the input lines, the input terminals and the output lines are formed on the surface on which the semiconductor device is mounted. The output terminals are formed on the surface opposite to the semiconductor-device mounting surface. Furthermore, a via hole for connecting each of the output terminals to a corresponding one of the output lines is bored in each of the circuit boards. Further, an input bus line is formed by connecting the two sets of the input lines, which are connected to the sets of the input terminals, with each other through the terminals of the semiconductor device. Similarly, a bus line path for connecting the semiconductor devices of the adjoining circuit boards with each other is constituted. Additionally, in this case, there may be provided a cascade connection as in the case of the first embodiment.

Further, in accordance with another embodiment of the present invention, in each of the circuit boards, the input lines, the input terminals, the output lines and the output terminals are formed on the surface on which the semiconductor device is mounted. Moreover, an input bus line is formed by the input lines connecting one of the two sets of the input line with the other set of the input terminals through the terminals of the semiconductor device. Moreover, a bus line path for connecting the semiconductor devices of the adjoining circuit boards with each other is constituted. In this case, it goes without saying that there may be provided the aforementioned cascade connection.

In accordance with the present invention, with the aforementioned configuration, the number of via holes to be formed in the circuit board can be reduced. Alternatively, the via holes can be excluded therefrom. Moreover, the mounting area of the circuit board can be small. The thickness thereof can be decreased.

Further, in accordance with still another embodiment of the present invention, a plurality of semiconductor devices can be mounted on each of the aforementioned circuit boards. A plurality of

semiconductor devices can be simultaneously connected to one another in one connecting process by mounting such circuit boards in an electronic apparatus.

Moreover, in accordance with the present invention, there is provided a method for mounting a semiconductor device in an electronic apparatus. This method is characterized by comprising the step of preparing a circuit board having a semiconductor device mounted on one of the surfaces thereof, input and output lines for the semiconductor device and one of input and output terminals provided on the same surface, and the other of the input and output terminals provided on the other of the surfaces thereof, wherein the other of the input and output terminals is connected through a via hole to the corresponding input or output line provided on the one of the surfaces, and wherein an input bus line and the input terminal are provided on the same surface. This method is characterized by further comprising the step of mounting the circuit board in the electronic apparatus by connecting the output terminal to a corresponding terminal of the electronic apparatus.

Furthermore, in accordance with the present invention, there is provided a method for mounting a semiconductor device in an electronic apparatus, which comprises the step of preparing a circuit board having a semiconductor device mounted on one of the surfaces thereof and input and output lines for the semiconductor device, input and output terminals and an input bus line provided on the same surface and the step of packaging the circuit board in the electronic apparatus by connecting the output terminal to a terminal of the electronic apparatus.

Especially, in the case of applying the structure of the present invention for mounting semiconductor devices to a liquid crystal display, there is provided a liquid crystal display, characterized by comprising a plurality of circuit boards being respectively provided with the semiconductor devices and having two sets of input lines and a set of output lines, two sets of input terminals respectively connected to the sets of the input lines, a set of output lines connected to the set of the output lines, and an input bus line interconnecting the sets of the input terminals, and characterized in that the output terminal of each of the circuit boards is connected to a corresponding terminal of the electronic apparatus and that each of the circuit boards is mutually connected with another adjoining one of the circuit boards by electrically connecting each of the sets of the input terminals of each of the circuit board to one of the sets of the input terminals of the adjoining one of the circuit boards.

Thereby, the frame portion formed on the outside of the displaying portion of the liquid crystal panel can be reduced. Thus the displaying portion can be substantially enlarged. Consequently, a compact liquid crystal display suitable for the downsizing thereof can be obtained.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1
is a plan view of a liquid crystal display to which the structure of the first embodiment of the present invention for mounting semiconductor devices is applied;

FIG. 2
is a plan view of a circuit board used in the liquid crystal display of FIG. 1;

FIG. 3
is a partially enlarged sectional view taken on line III-III of FIG. 1 for illustrating how the circuit board of the first embodiment is connected to an LCD cell;

FIG. 4
is a sectional diagram for illustrating an example of the modification of the circuit board of the first embodiment similarly as in the case of FIG. 3;

FIG. 5
is a partially enlarged diagram for illustrating how adjoining circuit boards of the liquid crystal display of FIG. 1 are connected to each other;

FIG. 6
is a partially enlarged diagram for illustrating another embodiment connecting circuit boards with each other by means of an FPC (Flexible Printed Circuit), similarly as in the case of FIG. 5;

FIG. 7
is a sectional diagram for illustrating how the circuit board of the second embodiment is connected to an LCD cell, similarly as in the case of FIG. 3;

FIG. 8
is a sectional diagram for illustrating an example of a modification of the second embodiment;

FIG. 9
is a plan view of a circuit board of a third embodiment of the present invention, on which two LCD driving LSIs are mounted;

FIG. 10
is a plan view of a circuit board which is an example of a modification of the circuit board of FIG. 9;

FIG. 11
is a perspective view of a liquid crystal display wherein a circuit board, on which a large number of LCD driving LSIs are mounted, is connected to the peripheral part of an LCD cell;

FIG. 12
is a plan view of a circuit board to be used in

the structure of a fourth embodiment of the present invention for mounting semiconductor devices;
FIG. 13
is a sectional view of the circuit board, taken on line XII-XII of FIG. 12;
FIG. 14
is a sectional diagram for illustrating how the circuit board of the fourth embodiment is connected to an LCD cell;
FIG. 15
is a sectional diagram for illustrating an example of a modification of the circuit board of the fourth embodiment, similarly as in the case of FIG. 13;
FIG. 16
is a sectional diagram for illustrating how the circuit board of FIG. 15 is connected to an LCD cell;
FIG. 17
is a sectional view of a circuit board, which is another example of a modification of the fourth embodiment, taken on line XVI-XVI of FIG. 12;
FIGS. 18(a) and 18(b)
are a plan view and a side view for illustrating how adjoining circuit boards are connected with one another when a plurality of circuit boards of the modification of FIG. 17 are connected to an LCD cell;
FIGS. 19(a) to 19(c)
are sectional views of other examples of modifications of the circuit board of the fourth embodiment;
FIG. 20
is a perspective view of a further embodiment of the present invention for connecting a plurality of circuit boards to an LCD cell;
FIG. 21
is a perspective view of an example of a modification of the embodiment of FIG. 20;
FIG. 22
is a plan view of the displaying portion and the dead area of a liquid crystal display;
FIG. 23
is a sectional view of an electronic printer in which a driving LSI is mounted by applying the first embodiment of the present invention;
FIG. 24
is a sectional view of an electronic printer using the circuit board of the fourth embodiment, similarly as in the case of FIG. 23;
FIG. 25
is a sectional view of an electronic printer using the circuit board of FIG. 15, which is the example of a modification of the fourth embodiment;
FIG. 26
is a sectional diagram for illustrating the structure for mounting a semiconductor device using a prior art multilayer circuit board; and
FIG. 27
is a plan view of the circuit board of FIG. 26.

BEST MODE FOR CARRYING OUT THE INVENTION

As illustrated in FIG. 1, in a liquid crystal display 1 to which the structure for mounting semiconductor devices according to the present invention is applied, a large number of circuit boards 3 are connected in line serially along the top, bottom and left sides of the peripheral portion of an LCD cell 2 having X-electrodes and Y-electrodes of an ordinary matrix structure. Further, as will be described later, an X-side liquid crystal driving LSI 4 is mounted on each of the circuit boards 3 connected to the top and bottom sides of the LCD cell 2 and, on the other hand, a Y-side liquid crystal driving LSI 4 is mounted on each of the circuit boards 3 connected to the left side thereof. Moreover, a link substrate 5 for connecting the input bus line of the circuit board provided on X-side with the input bus line of the circuit board provided on Y-side is provided in each of the upper left corner portion and the lower left corner portion of the LCD cell 2. Moreover, a cable 6 for supplying electric power and a power signal to each of the circuit boards is connected to the link substrate 5 provided on the lower left portion of the LCD cell 2.

The circuit board 3 is made of a relatively hard material such as ceramics, glass epoxy resin or polyimide resin and is shaped like a long and narrow rectangle elongated in the longitudinal direction as illustrated in FIG. 2. A liquid crystal driving LSI 4 similarly shaped like a long and narrow rectangle is mounted on a lower half of a surface 7 of the circuit board 3 at an almost central position in the longitudinal direction thereof through a face down bonding. Naturally, in another embodiment, an LSI having an outline shape other than a rectangle, for instance, a substantially square shape may be used, if necessary. The outline form of the circuit board 3 may be changed correspondingly. Further, depending on conditions or requisites for use, for example, when the contents of data to be displayed on the liquid crystal display are increased and thus the frequency of a signal representing the data becomes high, it may become necessary to provide an electric grounding layer in the circuit board 3. In such a case, an electrically conductive layer is provided in the circuit board 3 as the grounding layer.

On an upper half of the LSI mounting surface, namely, the surface 7 of the circuit board 3, a set of output terminals 8, the number of which is equal to that of the output terminals of the LSI 4, are formed in line at a constant pitch along the top side

in the longitudinal direction thereof and are connected to corresponding output lines 9 provided between the surface 7 and the LSI 4, respectively. Usually, the pitch of the output terminals 8 is about 100 to 200 µm or so. However, a narrow pitch equal to or less than 50 µm can be realized by appropriately selecting the material of the output terminals and the kind of a film generating process.

On the surface opposite to the LSI mounting surface 7 of the circuit board 3, namely, on the back surface 10 of the board 3, a set of input terminals 11, the number of which is equal to that of the input terminals of the LSI 4, are provided in line at a constant pitch along each of the left and right sides of the LSI 4. In the case of this embodiment, the pitch of the input terminals 11 is about 100 to 300 µm or so. Further, the pattern of input lines 12 is formed in such a manner that each of the input lines 12 extends to the position of the corresponding input terminal 11 from the LSI 4 to the left or right side of the circuit board. Each of the input terminals 11 is connected to the corresponding input line 12 through a via hole 13. Thereby, the input terminals are connected to the LSI 4. In the case of this embodiment, the diameter of the via holes 13 is 100 µm and may be suitably changed, if necessary. Further, the pattern of input bus lines 14 for connecting each of the input terminals 11 provided on the left side portion and the input terminals 11 provided on the right side portion with each other is formed on the back surface of the circuit board 3.

In the case of this embodiment, the left and right sets of the input terminals 11 are connected to the input terminals of the LSI through the input lines 12, as illustrated in this figure. Thus, each of the input terminals 11 provided on the left side portion of the circuit board 3 and the corresponding one of the input terminals 11 provided on the right side portion thereof are connected with each other through the input lines 12 by way of the input terminals of each of the LSI, so that second input bus lines consisting of the input lines 12 are provided on the LSI mounting surface 7 of the circuit board in addition to and parallel to the input bus lines 14 provided on the back surface 10 thereof. Consequently, the input bus lines of all of the circuit boards 3 can have a small resistance.

Moreover, in the case where the LSI 4 is of the long, narrow and slim type as illustrated in FIG. 2, the inside thereof may be divided into, for example, left and right blocks and sometimes an LSI input terminal is provided in each of the blocks, separately. In such a case, the LSI input terminal of each of the blocks is connected to the closer one of the left and right input terminals 11 through the input lines 12. Thus the same signal is supplied to the LSIs from the left or right input terminal, independently. Moreover, in accordance with this embodiment, the input terminals 11 provided on the left side portion are connected with the LSI through the input lines 12 provided on the left side portion and, further, outputs of the LSIs are connected with the input terminals 11 provided on the right side portion through the input lines 12 provided on the right side portion, whereby a cascade connection for connecting LSIs of adjoining left and right circuit boards in series may be applied thereto.

Practically, these embodiments may be appropriately combined with one another according to the requirements of the configurations of the circuit boards and the LSIs. For example, an embodiment may be constituted as follows. Namely, a part of the inside of the LSI 4 (for instance, a power supply system) is divided into blocks. A part of signals are input from the input terminals and lines provided on the left and right side portions, separately, and another part of the signals are transmitted to the LSI of an adjoining circuit board through the cascade connection, for example, the input terminals and lines provided on the right side thereof. Moreover, the remaining part of the signals are transmitted through the input bus lines consisting of the left and right input lines connected with one another by way of the input terminals of the LSI.

These lines 9, 12 and 14 and the terminals 8 and 11 may be made of a single element Au. Alternatively, these lines and terminals may be formed by using AgPd, Ag and Cu as materials of a base and by plating the base with Ni•Au, Sn or the like, if necessary. Moreover, if necessary, the surfaces of these lines and terminals are coated with a solder resist, thereby preventing corrosion thereof and avoiding damage thereto. Similarly as in the case of these lines and terminals, the via holes 13 are formed with a metal material such as Au. Alternatively, the via holes 13 are formed by using AgPd, Ag and Cu as materials of a base and by plating the base with Ni•Au, Sn or the like, if necessary. Moreover, if necessary, the surfaces of the via holes 13 are coated with a solder resist. Furthermore, the LSI 4 mounted on the circuit board 3 is coated with a molding material 15 containing an adhesive such as an ultraviolet setting type resin or thermosetting type epoxy, if necessary. Thereby, the moisture-resistance and the insulating strength thereof can be increased. Consequently, the reliability thereof can be improved.

Referring to FIG. 3, there is shown a structure in which the driving LSI 4 is mounted to the liquid crystal display 1 by connecting the circuit board 3 with the LCD cell 2. Further, LCD terminals 17 connected to the electrodes are formed like lines corresponding to the output terminals 8 of the

circuit board 3 at a predetermined pitch on the top surface of a peripheral portion of a lower transparent electrode substrate 16, on which the electrode pattern of the LCD cell 2 is formed. Each of the LCD terminals 17 is usually made of an ITO (Indium Tin Oxide) transparent electrode. If necessary, each of the LCD terminals 17 may be plated with a metal such as Cr, Ni, Au or Cu or with the combination of such metals.

In the case of the circuit board 3, the output terminals 8 are electrically and mechanically connected with the LCD terminals 17 at the same time by aligning each of the output terminals 8 to the corresponding LCD terminal 17 and simultaneously inserting an ACF, namely, an anisotropic conductive film 18 therebetween and thereafter performing a thermocompression bonding thereon by means of a predetermined pressuring and heating tool. In the case of this embodiment, a film of the AC6000 or AC7000 series of the thermosetting type manufactured by Hitachi Chemical Co., Ltd., is used as the ACF 18. Incidentally, for example, a film of the UV setting type or a paste-like anisotropic conductive adhesive may be used as the ACF. Further, a molding material 19 is provided at the connection portion between the LCD cell 2 and the circuit board 3.

In the case of another embodiment, a bump 20 made of Au, Cu or the like is formed on the output terminals 8 of the circuit board 3 as shown in FIG. 4.

As shown in FIG. 5, the adjoining circuit boards 3 and 3', which are connected to the LCD cell 2, are connected with each other by interconnecting the adjacent input terminals 11 and 11' through wire bonding by use of wires 21 made of a metal such as Au, Al and Cu or of an alloy of such metals. Thereby, the input bus lines 14 of all of the circuit boards 3 mounted serially on the circumference of the LCD cell 2 are connected with one another. Practically, it is convenient for performing a wire bonding on the input terminals of the adjoining circuit boards that an appropriate supporting member is provided under the circuit boards 3 and 3'. Moreover, in the case of a further embodiment, the input terminals 11 and 11' of the adjoining circuit boards 3 and 3' can be interconnected by using an FPC 22, on the surface of which the pattern of the lines are formed, as illustrated in FIG. 6.

Further, in the case of the aforementioned embodiment, the LSI 4 has input/output terminals 23 provided with a bump made of Au or the like and is directly connected with the input and output lines 12 and 9 of the circuit board 3 by employing a face down method. However, each input/output terminal of the LSI 4 upwardly fixed on the circuit board 3 by employing a face up method may be connected to the input and output lines through wire bonding.

Thus, in the case of the structure for mounting semiconductor devices according to the present invention, the output terminals 8 of the circuit board 3 are provided on the same surface 7, on which the LSI 4 is mounted, in such a manner to be connected with the terminals 17 of the LCD cell 2. Thereby, there is no necessity of boring via holes in the circuit board to connect the output lines with the output terminals, different from the mounting structure described in the specification of Japanese Patent Application No. 5-223523/1993. Especially, the number of the output terminals is much larger than the number of the input terminals. As described above, the number of the output terminals is 80 to hundreds per semiconductor device. Thus, a compact and low-priced circuit board can be formed by eliminating the via holes for the output terminals. Moreover, the area of the circuit board can be effectively utilized. Furthermore, the degree of freedom of the wiring can be increased. Additionally, the outline form of the circuit board 3 can be small in size. In addition, the thickness thereof can be reduced by eliminating the intermediate conductive layers.

Thereby, the frame portion located in the circumferential portion of the LCD cell 2, namely, as shown in Fig. 1, the mounting region indicated as of a dimension A which is a circumferential portion of the displaying portion 24 of the liquid crystal display 1 can be very small in size. Further, as a result of realizing the thin circuit board 3, the thickness of the LSI 4 can be fallen within the range of the thickness thereof when the circuit board is mounted in the LCD cell 2. Therefore, the structure for mounting semiconductor devices can be compact. Consequently, the entire liquid crystal display 1 can be downsized. Moreover, in the case of other embodiments, the structure of the present invention for mounting semiconductor devices can be applied to only one, two or all of the four sides of the LCD cell 2l. In such cases, similar functions and effects can be obtained.

FIG. 7 shows another structure for mounting semiconductor devices, namely, the second embodiment of the present invention. The circuit board 3 of this embodiment is shaped like a long and narrow rectangle which is nearly the same as the form of the circuit board of the first embodiment of FIG. 2. Moreover, the LCD driving LSI 4 is mounted nearly in the central portion thereof. In addition to the output lines 9 and the input lines 12, a set of input terminals 11, the number of which is equal to that of the input terminals of the LSI 4, are formed along each of the left and right sides thereof. The input terminals 11 formed along the left side and the input terminals 11 formed along the right side thereof are connected with the input

terminals of the LSI 4 through the corresponding left and right input lines 12. Namely, the left and right input lines 12 for connecting the input terminals 11 provided along the left and right sides with one another through the input terminals of the LSI 4 constitute the input bus lines 14 simultaneously. Further, in the case of this embodiment, there may be employed the combination of cascade connections, in each of which an output of the LSI corresponding to a signal input from the input line 12 provided along the left side thereof is sent to the LSI of another circuit board through the input line 12 provided along the right side thereof and is thereafter output from the latter LSI.

Similarly as in the case of the circuit board of the first embodiment, a set of output terminals 8 are formed along the top side of the surface 10 opposite to the LSI mounting surface 7 of the circuit board 3 in the longitudinal direction. Moreover, this set of the output terminals 8 are connected to the corresponding output lines 9 through a via hole 25, respectively. The circuit board 3 is similarly electrically and mechanically connected with the LCD cell 2 by aligning each of the output terminals 8 to the corresponding LCD terminal 17 provided on the electrode substrate 16 and inserting the ACF 18 and thereafter performing a thermocompression bonding thereon. In the case of this embodiment, the adjoining circuit boards 3 are connected with each other by connecting the adjacent input terminals 11 by using a wires or an FPC.

In the case of this embodiment, when designing the input lines 12, namely, the input bus lines, the mounting of the input lines on the LSI mounting surface 7 has an advantage in achieving a larger pitch of the input lines, as compared with the mounting thereof on the opposite surface 10 which requires a bonding area to be bonded to the electrode substrate 16. Moreover, if the input lines are provided on the surface 7, there is no necessity of providing via holes for connecting the input lines with the input terminals 11. Thus, although this embodiment is not so effective as the aforementioned first embodiment, the circuit board 3 can be compact. Further, the cost can be reduced and the area of the board can be effectively utilized.

FIG. 8 illustrates an example of a modification of the aforesaid second embodiment. The peripheral portion of the electrode substrate 16 is expanded to a region, the horizontal section of which contains that of the entire circuit board 3. Thereby, not only the output terminals 8 but the entire bottom surface 10 of the circuit board 3 can be bonded onto the electrode panel 16. Consequently, the circuit board 3 can be mechanically connected to the LCD cell 2 more firmly and securely.

FIG. 9 shows another structure for mounting semiconductor devices, namely, a third embodiment of the present invention, in which two LCD driving LSIs are mounted on one circuit board. This circuit board 31 has a configuration similar to that of the circuit board 3 of the first embodiment of FIG. 2. Further, the circuit board 31 is shaped like a band plate which is longer and narrower in the direction from left to right than the circuit board 3. On a surface 7 of the circuit board 31, two LSIs 4 and 4' are mounted in series along one of the sides by performing a face down bonding.

On the LSI mounting surface 7, each set of the output terminals 8 and 8' of an equal number corresponding to output terminals of each of the LSIs 4 and 4' are placed in line at a constant pitch along the other side in the longitudinal direction. The output terminals of each of the sets are connected to the output lines 9 and 9', the patterns of which are formed in such a manner to extend from the corresponding LSIs 4 and 4', respectively. On the back surface 10 of the circuit board 3, sets of input terminals 11 and 11' of a number being equal to that of the input terminals of the LSIs 4 and 4' are placed at a constant pitch on the left and right side portions, respectively. The left and right sets of the input terminals are interconnected through input bus lines 14, the pattern of which is formed in such a manner to extend in the longitudinal direction on the back surface of the circuit board.

Further, on the LSI mounting surface 7, the pattern of each of input lines 12 and 12' of the LSIs 4 and 4' is formed. The input lines 12 and 12' extending from the LSIs to the left and right side portions of the circuit board 3 are connected with the corresponding input terminals 11 and 11' through via holes 13 and 13', respectively. Moreover, the input lines 12 and 12' extending between the LSIs 4 and 4' are interconnected and are also connected with the input bus lines 14 through via holes 13".

Therefore, similarly as in the case of the circuit board 3 of the first embodiment, the input terminals 11 provided on the left side portion of the circuit board 31 are connected with the input terminals 11' provided on the right side portion thereof through the input lines 12 and 12' by way of the input terminals of both of the LSIs, respectively. Thereby, in addition to the aforementioned input lines 14, the second input bus lines are provided on the LSI mounting surface 7. As a whole, the input bus lines can have a small resistance.

Furthermore, similarly as in the case of the first embodiment, if the LSIs 4 and 4' are of the long and narrow slim type and the inside thereof is divided into blocks, the input terminals of the left or right block of each of the LSIs are connected with the input terminals 11 and 11' provided along the closer one of the left and right sides through the input lines 12 and 12'. Moreover, the input termi-

nals of the other block of each of the LSIs are connected with the input bus lines 14 through the input lines 12 and 12' and the common via holes 13". Thus, the same signal is supplied to the left and right blocks, independently. Further, the wiring may be performed in such a manner to contain the following cascade connections or the combination thereof. Namely, in the cascade connection, the input terminals 11 provided along the left side are connected to the LSI 4 on the left side through the input lines 12 provided on the left side portion. Further, an output of the LSI 4 is connected to the LSI 4' on the right side through the input lines 12 and 12' provided between both of the LSIs. Moreover, an output of the LSI 4' is connected to the input terminal 11' provided along the right side through the input lines 12' on the right side portion.

The circuit board 31 is connected with the LCD cell at a time by using an ACF and aligning each of the output terminals 8 and 8' to the corresponding LCD terminal of the electrode substrate, similarly as in the case of the third embodiment. Thus, in accordance with this embodiment, two liquid crystal driving LSIs are mounting on an LCD cell in one connecting process. Further, the input terminals of the adjoining circuit boards 31 are interconnected by performing a wire bonding or by using an FPC. Thereby, a bus line path for connecting the adjoining circuit boards is formed.

Moreover, in the case of this embodiment, the circuit board 31 can be constructed so that the output terminals are provided on the LSI mounting surface, similarly as in the case of the second embodiment of FIG. 2. FIG. 10 illustrates a structure for mounting semiconductor devices, which is an example of such a modification. The circuit board 31 of this figure is shaped like a long and narrow band plate, similarly. Moreover, on one of the surfaces thereof, namely, the surface 7, two LSIs 4 and 4' are connected in series with each other in the longitudinal direction by performing a face down bonding.

On the LSI mounting surface 7, one set of input terminals 11 and 11' are placed at a constant pitch on each of the left and right sides thereof, respectively. Moreover, the pattern of input lines 12 and 12' is formed in such a manner to extent from each of the input terminals to each of the LSIs 4 and 4'. Furthermore, the pattern of output lines 9 and 9' from the LSIs 4 and 4' is formed in such fashion to extend to the top side of the LSI mounting surface 7. On the back surface 10 of the circuit board 3, sets of output terminals 8 and 8' for connection to an LCD cell are placed like lines at the positions corresponding to the output lines 9 and 9' along one side in the longitudinal direction thereof and are further interconnected through via holes 25 ad 25' bored through the circuit board 3.

Moreover, on the LSI mounting surface 7 of the circuit board 31, there is formed the pattern of input bus lines 14 for connecting lands, to which the input terminals of the LSIs 4 and 4' are connected, respectively. Thereby, the input terminals 11 and 11' are connected with one another through the input lines 12 and 12' and the input bus lines, so that a bus line path for connecting the adjoining circuit boards with each other is formed.

Furthermore, in accordance with the present invention, a large number of semiconductor devices can be simultaneously mounted in one connecting process by mounting three or more semiconductor devices on a single circuit board. Such a preferred embodiment of the present invention is shown in FIG. 11. As shown in this figure, long and narrow band-like circuit boards 32 to 34 are connected to the top, bottom and left sides of the peripheral portion of an LCD cell 2, respectively. Further, eight X-side driving LSIs 41 and 42 are mounted on each of the circuit boards 32 and 34, respectively, and, on the other hand, four Y-side driving LSIs 43 are mounted on the circuit board 33 in such a manner that the driving LSIs are mounted on one of the surfaces of each of these circuit boards in the longitudinal direction in line serially.

Each of the circuit boards 32 to 34 has nearly the same configuration as that of the embodiment of FIG. 10. On the LSI mounting surface, the pattern of input lines connected to input terminals of the sets provided on the left and right sides thereof and the pattern of input bus lines for connecting adjoining LSIs with each other are formed. On the surface opposite to the LSI mounting surface, output terminals for each of the LSIs are formed along one of the sides thereof in the longitudinal direction. Therefore, each of the circuit boards 32 to 34 is easily connected to the electrode substrate 16 at a time by using an ACF between the output terminals and the electrode substrate 16.

Further, a link substrate 5 is provided on the upper left corner portion of the LCD cell 2. The link substrate 5 interconnects the X-side circuit board 32 and the Y-side circuit board 33 through the input terminals. On the lower left corner portion of the LCD cell 2, a link substrate 5' being integral with a cable extending to the outside is provided in such a manner to connect the lower X-side circuit board 34 with the Y-side circuit board 33. Thus, electric power, input signals and so forth can be supplied from an external circuit to each of the circuit boards. Further, naturally, no input terminals need be provided on the right or left side portion of the X-side circuit boards 32 and 34, to which no Y-side circuit board is connected.

In accordance with the present invention, a large number of liquid crystal driving LSIs are mounted by connecting a circuit board to and

along each of the sides of an LCD cell. Thereby, the number of man-hours can be reduced and operations can be facilitated. Consequently, the productivity can be increased and the manufacturing cost can be reduced. Simultaneously, similarly as in the case of each of the aforementioned embodiments, the mounting area of the liquid crystal display can be reduced drastically, as compared with the conventional case. For example, as illustrated in FIG. 22, in case where a 20-cm (namely, 8-inch) liquid crystal panel is manufactured by employing the mounting structure of the present invention, the size of a frame portion, namely, a dead area formed in the peripheral portion can be reduced from the width of the conventional panel, that is, A1 = 9 mm to the width A2 = 5 mm even when the outside dimension of the panel is maintained. Thereby, in the case of the liquid crystal panel having the same outside dimension, the size of the displaying portion can be changed from D1 = 20 cm to D2 = 22 cm (namely, 8.7 inches). The displaying area can be enlarged substantially.

Further, this embodiment can be configured so that a circuit board 35 can have output terminals on the LSI mounting surface thereof, similarly as in the case of the circuit board 3 of the first embodiment of FIG. 2. In such a case, two liquid crystal LSIs can be mounted on the circuit board, similarly.

FIGS. 12 and 13 show a circuit board 35 of a structure for mounting semiconductor devices, which represents a fourth embodiment of the present invention. The circuit board 35 of this embodiment is shaped like a long and narrow rectangle, similarly as in the cases of the circuit boards of the aforesaid first to third embodiments. The pattern of output terminals 8, output lines 9, input terminals 11 and input lines 12 is formed on the mounting surface 7 of the LCD driving LSI 4. Thus, the circuit board of this embodiment has no via holes. The circuit board of this embodiment is different in this respect from those of the first to third embodiments. In this way, the configuration of the circuit board 35 itself can be extremely simplified and the manufacturing cost can be further decreased by using no via holes for connecting output or input lines with output or input terminals.

Further, input terminals 11, equal in number to the number of a set of input terminals, are provided on each of the left and right side portions of the circuit board 35 and are connected to the LSI input terminals through the input lines 12, respectively. Simultaneously, the input bus lines for connecting another adjoining circuit board therewith are formed by the input lines 12 for interconnecting the input terminals provided on the left and right side portions. Furthermore, similarly as in the case of each of the aforementioned embodiments, a cascade connection, in which an output of the LSI corresponding to a signal input from the input line 12 provided on the left side thereof is sent to an LSI of another circuit board through the input line provided on the right side portion thereof and is further output therefrom, can be incorporated into this embodiment.

As illustrated in FIG. 14, the output terminals 8 the circuit board 35 of this embodiment are connected with the LCD terminals 17 of the electrode substrate 16 by using an ACF 18 similarly as in the case of each of the embodiments. Further, the LSI 4 is provided on the side of the electrode substrate 16 within the range of the thickness of the substrate 16 by connecting the circuit board 35, which is thinned in this manner and has the LSI 4 and the output terminals 8 on the same surface thereof, to the LCD cell 2. Thus, the thickness of the entire liquid crystal display can be decreased.

Further, the circuit board 35 of the present invention is formed in such a manner that the input terminals 8, the output lines 9, the input lines 12 and the input terminals 11 are buried under the surface of the LSI mounting surface 7 thereof as illustrated in FIG. 13. Therefore, the surface of the output terminals 8, which is on the back surface side 10 of the circuit board 35 can be exposed by deleting a part of the back surface 10 to make a window portion 26, as illustrated in, for example, FIG. 15.

The circuit board 35 can be connected to the LCD terminals 17 of the electrode substrate 16 from the side of the back surface 10 as illustrated in FIG. 16 by exposing the output terminals 8 on both of the top and bottom surface sides of the circuit board 35. In this case, the entire surface of the circuit board 35 can be bonded onto the electrode substrate 16. Consequently, the circuit board can be fixed more securely and stably. The window portion 26 of the circuit board 35 can be easily formed by, for instance, eliminating a part of the back surface 10 selectively by means of, for example, an excimer laser processing.

Another embodiment of the circuit board 35, in which a window portion is bored, is shown in FIG. 17. In the case of the circuit board 35 of the fourth embodiment, the input terminals 11 are provided thereon and the left and right side portions are protruded outwardly therefrom somewhat as illustrated in FIG. 12. In the case of the example of the modification of FIG. 17, the input terminals 11 are exposed on the back surface side 10 by deleting the left and right side portions of the back surface 10. In the case where a plurality of the circuit boards 35 are mounted side by side to the peripheral portion of the LCD cell 2 by exposing the input terminals 11 on both of the top and bottom surface sides of each of the circuit boards 35, the adjacent input terminal portions 11 are overlapped as illus-

trated in FIG. 18 and can be connected with each other by using ACFs or performing a soldering or the like. In this case, there is no necessity of employing a wire bonding or an FPC, different from the aforementioned first and second embodiments. Thus, a connecting operation can be easily achieved. Moreover, the reliability of the connection portion can be increased. Furthermore, the number of components can be decreased. Consequently, the cost can be reduced.

FIGS. 19(a) to 19(c) illustrate other examples of modification of the circuit board of the fourth embodiment, respectively. In the case of the circuit board 35 of FIG. 19(a), the window portion 27 is provided in a region of the back surface 10 corresponding to the LSI 4. Further, in the circuit board of FIG. 19(b), a window portion 28 for exposing the output terminals 8 similarly as in the case of FIG. 14 is bored and formed in addition to the window portion 27 of FIG. 19(a). Moreover, in the circuit board of FIG. 19(c), a window portion 29 for exposing nearly the entire back surface 10 of the circuit board containing the output terminals 8, the output lines 9 and the input lines 12 is provided. In the cases of these example of modification, as a result of providing a window portion corresponding to an area, on which the LSI 4 is mounted, in the back surface 10 of the circuit board 35, a heating tool can be applied directly to the input lines 12 and the output lines 9 when mounting the LSI 4 on the circuit board 35. Consequently, the input and output terminals of the LSI 4 can be more easily connected to the input and output lines 12 and 9, respectively, by performing a gang bonding.

In FIGS. 20 and 21, other configurations for connecting the circuit board 35 of the fourth embodiment with the LCD cell 2 are illustrated, respectively. In the case of the embodiment of FIG. 20, the input terminals 11 are placed along one of the sides in the longitudinal direction on both of the left and right sides of the row of the output terminals 8, instead of both of the left and right sides of the circuit board 35. In the back surface opposite to the LSI mounting surface 7 of the circuit board 35, a window portion (not shown) for exposing the output terminals 8 and the input terminals 11 is bored similarly as in the case of FIG. 17.

In the peripheral portion of the electrode substrate 16 of the LCD cell 2, in addition to the pattern of the LCD terminals 17 connected to the X-electrodes or Y-electrodes, the patterns of panel connecting terminals 30 are similarly formed at positions corresponding to the input terminals 11 of the circuit board 35 along the circumferential edge of the electrode substrate 16. Moreover, on the electrode substrate 16, in order to connect the circuit board with another adjoining circuit board 35', the patterns of the LCD terminals 17' and the panel connecting terminals 30' are similarly formed along the circumferential edge of the electrode substrate 16

The panel connecting terminals 30 of the circuit board 35 are interconnected with the panel connecting terminals 30 of the adjacent circuit board 35', respectively, through bus lines 36, the pattern of which is formed on the electrode substrate 16. Therefore, the input terminals 11 and 11' of both of the circuit boards 35 and 35' are simultaneously interconnected when the circuit boards 35 and 35' are connected with the electrode substrate 16 by aligning the output terminals 8 and 8' and the input terminals 11 and 11' thereof to the corresponding LCD terminals 17 and 17' and the corresponding panel connecting terminals 30 and 30', respectively, and by then performing a thermocompression bonding thereon by use of, for example, ACFs.

Thus, in the case of this embodiment, the adjoining circuit boards are connected with each other and the input bus lines are also connected with each other only by mounting each of the circuit boards on the electrode substrate without using a wire bonding and an FPC. Therefore, this embodiment has advantages in that a connecting operation can be facilitated and the number of man-hours can be reduced. Moreover, in the case of this embodiment, the output terminals 8 and the input terminals 11 of the circuit board 35 are placed in line, so that a pressuring head can have a simple linear shape and moreover, a bonding apparatus can have a simple configuration.

Further, the embodiment of FIG. 20 employs a circuit board having the same configuration as illustrated in FIG. 17, in which a window portion is bored in the back surface of the circuit board to expose the input and output terminals. However, so long as at least the output terminals and the input terminals are provided on the same surface, a circuit board having another configuration may be employed. For example, the circuit board having a configuration of FIG. 12, the back surface of which has no window portion, may be employed. In this case, the circuit board 35 is connected to the electrode substrate 16 in such a manner that the LSI 4 is placed on the side of the electrode substrate 16 and in the range of the thickness thereof, similarly as in the case of FIG. 14.

In the case of the embodiment of FIG. 21, each of the LCD terminals 17 and the panel connecting terminals 30 is placed in the inside of the electrode substrate 16. The pattern of bus lines 36 is formed outside such terminals. The circuit board 35 has the same configuration as that of the embodiment of FIG. 20 and is connected to the electrode substrate 16 at a time by using an ACF or the like.

In the case of this embodiment, the length of the lines drawn from the LCD terminals 17 to the X-electrodes or Y-electrodes of the LCD cell 2 becomes shorter than that of the case of the embodiment of FIG. 20. Thus this embodiment has an advantage in that the resistance of these lines becomes small. Furthermore, the size of the peripheral portion of the electrode substrate 16, on which the LCD terminals and so on are formed, can be smaller than that of the case of the embodiment of FIG. 20. Incidentally, in the case of this embodiment, it is necessary to save a region, on which a bus line is provided, outside the LCD terminals 17 and the panel connecting terminals 30 in the peripheral portion of the electrode substrate 16. Therefore, it is difficult to connect the circuit boards of FIG. 13, which have no window portion on the back surface thereof, with each other, similarly as in the case of the embodiment of FIG. 20.

In the foregoing description, a case, in which the structure of the present invention for mounting semiconductor devices is applied to a liquid crystal display as an example of an electronic apparatus, has been described. The present invention, however, can be similarly applied to other electronic display apparatuses such as an EL (electroluminescence) display, a plasma display and to an electronic printer such as a thermal printer.

FIGS. 23 to 25 illustrate embodiments of the structure for mounting driving LSIs in a thermal printer head used for an electronic printer. In the case of the embodiment of FIG. 23, a circuit board 44, on which a driving LSI 40 is mounted, is connected to a ceramic substrate 39, on which a heating portion 38 is formed, in a thermal printer head 37. The circuit board 44 has a configuration similar to that of the circuit board 3 of FIG. 1. Further, output lines 45, output terminals 46 and input lines 47 are formed on the surface, on which the driving LSI 40 is mounted, of the circuit board 44. In contrast, an input bus line for connecting the circuit board 44 with an LSI of a circuit board adjoining the input terminals 48 is formed on the opposite surface thereof. Moreover, the input terminals 48 and the input lines 47 are connected with each other through via holes 49. The circuit board 44 is electrically and mechanically connected with the head 37 by aligning thermal printer head terminals 50 formed on the substrate 39 of the thermal printer head 37 to the output terminals 46 and then performing a thermocompression bonding by means of an ACF 51.

In the case of the embodiment of FIG. 24, a circuit board 52 has a configuration similar to that of the circuit board 35 of FIG. 12. Moreover, the circuit board 52 is connected with the substrate 39 of the thermal printer head 37, similarly as in the case of FIG. 14. Furthermore, in the case of the embodiment of FIG. 25, a circuit board 53 has a configuration similar to that of the circuit board 35 of FIG. 15. Moreover, similarly as in the case of FIG. 16, the circuit board 53 is connected with the substrate 39 of the thermal printer head 37.

Thus, in accordance with the structure of the present invention for mounting semiconductor devices, in cases of applying such a structure not only to an electronic display but to various other electronic devices such as an electronic printer, the mounting area can be very small. Moreover, the thickness of the entire device can be small. Consequently, the present invention can respond to the demand for the downsizing of electronic devices and can realize a compact electronic device in what is called a dead area is very small.

Claims

1. A structure for mounting semiconductor devices in an electronic apparatus, the structure comprising:

   a plurality of circuit boards, on each of which a semiconductor device is mounted,

   wherein each of the circuit boards has two sets of input lines and a set of output lines, which are connected to the semiconductor device, and also has two sets of input terminals connected to the sets of input lines, respectively, and a set of output terminals connected to the set of output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

   wherein the output lines, the output terminals and the input lines are formed on the surface of each of the circuit boards, on which the semiconductor device is mounted, and the input terminals and the input bus lines are formed on an opposite surface of each of the circuit boards, and each of the input terminals is connected to a corresponding one of the input lines through a via hole,

   wherein each of the circuit boards is mounted in the electronic apparatus by connecting the output terminals thereof to corresponding terminals of the electronic apparatus, and

   wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

2. The structure for mounting semiconductor devices according to claim 1, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards through wire

bonding.

3. The structure for mounting semiconductor devices according to claim 1, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards by means of an FPC.

4. The structure for mounting semiconductor devices according to claim 1, 2 or 3, wherein the output terminals of the circuit boards are connected to the terminals of the electronic apparatus through an anisotropic conductive film.

5. A structure for mounting semiconductor devices in an electronic apparatus, the structure comprising:

a plurality of circuit boards, on each of which a semiconductor device is mounted,

wherein each of the circuit boards has two sets of input lines and a set of output lines, which are connected to the semiconductor device, and also has two sets of input terminals connected to the sets of input lines, respectively, and a set of output terminals connected to the set of output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

wherein the output lines, the output terminals and the input lines are formed on the surface of each of the circuit boards, on which the semiconductor device is mounted, and the input terminals and the input bus lines are formed on an opposite surface of each of the circuit boards, and each of the input terminals is connected to a corresponding one of the input lines through a via hole, and the input bus lines are constituted by the two sets of input lines connected to one another through the semiconductor device,

wherein each of the circuit board boards is mounted in the electronic apparatus by bonding the output terminals thereof to corresponding terminals of the electronic apparatus, and

wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

6. The structure for mounting semiconductor devices according to claim 5, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards through wire bonding.

7. The structure for mounting semiconductor devices according to claim 5, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards by means of an FPC.

8. The structure for mounting semiconductor devices according to claim 5, 6 or 7, wherein the output terminals of the circuit boards are connected to the terminals of the electronic apparatus through an anisotropic conductive film.

9. A structure for mounting semiconductor devices in an electronic apparatus, the structure comprising:

a plurality of circuit boards, on each of which a semiconductor device is mounted,

wherein each of the circuit boards has two sets of input lines and a set of output lines, which are connected to the semiconductor device, and also has two sets of input terminals connected to the sets of input lines, respectively, and a set of output terminals connected to the set of output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

wherein the output lines, the output terminals and the input lines are formed on a semiconductor device mounting surface of each of the circuit boards, on which the semiconductor device is mounted, and the input bus lines are constituted by the two sets of input lines connected to one another through the semiconductor device,

wherein each of the circuit boards is mounted in the electronic apparatus by bonding the output terminals thereof to corresponding terminals of the electronic apparatus, and

wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

10. The structure for mounting semiconductor devices according to claim 9, wherein the circuit board is mounted in the electronic apparatus by exposing the output terminals on a surface side opposite to the semiconductor device mounting surface and by connecting the exposed output terminals to the terminal of the electronic apparatus.

11. The structure for mounting semiconductor devices according to claim 9 or 10, wherein the circuit board is connected to the adjoining one of the circuit boards by exposing at least one

set of input terminals on the surface side opposite to the semiconductor device mounting surface, and the input terminals exposed on the opposite surface side and the input terminals of the adjoining one of the circuit boards are overlapped.

12. The structure for mounting semiconductor devices according to claim 9, 10 or 11, wherein the circuit board has an window portion for exposing the input lines and the output lines on the surface side opposite to the semiconductor device mounting surface, which are provided in an area where the semiconductor device is mounted.

13. The structure for mounting semiconductor devices according to claim 9, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards through wire bonding.

14. The structure for mounting semiconductor devices according to claim 9, wherein the input terminals of each of the circuit boards are connected to the input terminals of the adjoining one of the circuit boards by means of an FPC.

15. The structure for mounting semiconductor devices according to claim 9, 10, 11, 12, 13 or 14, wherein the output terminals of the circuit boards are connected to the terminals of the electronic apparatus through an anisotropic conductive film.

16. A structure for mounting semiconductor devices in an electronic apparatus, the structure comprising:

at least one circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines, a set of output terminals connected to the output lines and at least one set of input lines correspondingly to each of the semiconductor devices and also has at least one set of input terminals connected to the set of input lines, respectively, and input bus lines connected to the input terminals,

wherein the output lines, the output terminals and the input lines are formed on a semiconductor device mounting surface of the circuit board, on which the semiconductor devices are mounted, and the input terminals and the input bus lines are formed on an opposite surface of the circuit board, and the input bus lines of the circuit board are connected to the input terminals or the input lines through via holes, and

wherein the circuit board is mounted in the electronic apparatus by connecting the output terminals to corresponding terminals of the electronic apparatus.

17. The structure for mounting semiconductor devices according to claim 16, which comprises a plurality of the circuit boards, wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

18. A structure for mounting semiconductor devices in an electronic apparatus, the structure comprising:

at least one circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines and a set of output terminals and at least one set of input lines corresponding to each of the semiconductor devices, and also has at least one set of input terminals connected to the set of input lines, respectively, and input bus lines connected to the input terminals,

wherein the input lines, the input terminals and the output lines are formed on a semiconductor device mounting surface of the circuit board, on which the semiconductor devices are mounted, and the output terminals are formed on a surface opposite to the semiconductor device mounting surface of the circuit board, and each of the output terminals is connected to a corresponding one of the output terminals through a via hole, and the input bus lines are constituted by the input lines connected to one another through the semiconductor devices, and

wherein the circuit board is mounted in the electronic apparatus by connecting the output terminals to corresponding terminals of the electronic apparatus.

19. The structure for mounting semiconductor devices according to claim 18, which comprises a plurality of the circuit boards, wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

20. A structure for mounting semiconductor devices in an electronic apparatus, the structure

comprising:

at least one circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines, a set of output terminals connected to the output lines and a set of input lines corresponding to each of the semiconductor devices, and also has at least one set of input terminals connected to the set of input lines, respectively, and input bus lines connected to the input terminals,

wherein the input lines, the input terminals and the output lines are formed on a semiconductor device mounting surface of the circuit board, on which the semiconductor devices are mounted, and the input terminals and the input bus lines are constituted by the input lines connected to one another through the semiconductor devices, and

wherein the circuit board is mounted in the electronic apparatus by connecting the output terminals to corresponding terminals of the electronic apparatus.

21. The structure for mounting semiconductor devices according to claim 20, which comprises a plurality of the circuit boards, wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of input terminals with a set of input terminals of the adjoining one of the circuit boards.

22. A method for mounting a semiconductor device or semiconductor devices in an electronic apparatus, the method comprising the steps of:

preparing a circuit board, on one of surfaces of which a semiconductor device or semiconductor devices is/are mounted, input lines and an output lines and one of input and output terminals being provided on said one surface of the circuit board, the other of the input and output terminals being provided on the other of the surfaces of the circuit board, the other of the input and output terminals being connected to a corresponding one of the input and output lines through via holes, the input terminals and the input bus lines being provided on the same surface; and

mounting the circuit board in the electronic apparatus by connecting the output terminals with corresponding terminals of the electronic apparatus.

23. The method for mounting semiconductor devices according to claim 22, wherein the circuit board is mounted in the electronic apparatus by placing an anisotropic conductive film between the output terminal of the circuit board and the terminal of the electronic apparatus and by performing a thermocompression bonding of the film therebetween.

24. The method for mounting semiconductor devices according to claim 22 or 23, which further comprises the step of connecting a plurality of the semiconductor devices, which are to be mounted in the electronic apparatus in such a manner to adjoin, with each other by the adjacent input terminals of the adjoining semiconductor devices.

25. The method for mounting semiconductor devices according to claim 24, wherein the adjacent input terminals of the adjoining circuit boards are connected to each other through wire bonding.

26. The method for mounting semiconductor devices according to claim 24, wherein the adjacent input terminals of the adjoining circuit boards are connected to each other with an FPC.

27. A method for mounting semiconductor devices in an electronic apparatus, the method comprising the steps of:

preparing a circuit board, on one of surfaces of which a semiconductor device is mounted, input and output lines and input and output terminals and an input bus line being provided on said one surface of the circuit board; and

mounting the circuit board in the electronic apparatus by connecting the output terminals with corresponding terminals of the electronic apparatus.

28. The method for mounting semiconductor devices according to claim 27, wherein the circuit board is mounted in the electronic apparatus by placing an anisotropic conductive film between the output terminals of the circuit board and the terminals of the electronic apparatus and by performing a thermocompression bonding of the film therebetween.

29. The method for mounting semiconductor devices according to claim 27 or 28, which further comprises the step of connecting a plurality of the semiconductor devices, which are to be mounted in the electronic apparatus in such a manner to adjoin, with each other by the adjacent input terminals of the adjoining semiconductor devices.

30. The method for mounting semiconductor devices according to claim 29, wherein the adjacent input terminals of the adjoining circuit boards are connected to each other through wire bonding.

31. The method for mounting semiconductor devices according to claim 29, wherein the adjacent input terminals of the adjoining circuit boards are connected to each other by means of an FPC.

32. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

a plurality of circuit boards, on each of which the semiconductor device is mounted,

wherein each of the circuit boards has two sets of input lines and a set of output lines, which are connected to the semiconductor device, and also has two sets of input terminals connected to the sets of the input lines, respectively, and a set of output terminals connected to the set of the output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

wherein the output lines, the output terminals and the input lines are formed on the surface of each of the circuit boards, on which the semiconductor device is mounted, and the input terminals and the input bus lines are formed on an opposite surface of each of the circuit boards, and each of the input terminals is bonded to a corresponding one of the input lines through a via hole,

wherein each of the circuit board is mounted in the liquid crystal display by bonding the output terminals thereof to electrode terminals of the liquid crystal display, and

wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of the input terminals with a set of the input terminals of the adjoining one of the circuit boards.

33. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

a plurality of circuit boards, on each of which the semiconductor device is mounted,

wherein each of the circuit boards has two sets of input lines and a set of output lines, which are bonded to the semiconductor device, and also has two sets of input terminals bonded to the sets of the input lines, respectively, and a set of output terminals bonded to the set of the output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

wherein the output lines, the output terminals and the input lines are formed on the surface of each of the circuit boards, on which the semiconductor device is mounted, and the input terminals and the input bus lines are formed on an opposite surface of each of the circuit boards, and each of the input terminals is connected to a corresponding one of the input lines through a via hole, and the input bus lines are constituted by the two sets of the input lines connected to one another through the semiconductor device,

wherein each of the circuit board is mounted in the liquid crystal display by connecting the output terminals thereof to electrode terminals of the liquid crystal display, and

wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of the input terminals with a set of the input terminals of the adjoining one of the circuit boards.

34. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

a plurality of circuit boards, on each of which the semiconductor device is mounted,

wherein each of the circuit boards has two sets of input lines and a set of output lines, which are connected to the semiconductor device, and also has two sets of input terminals connected to the sets of the input lines, respectively, and a set of output terminals connected to the set of the output lines, respectively, and input bus lines for interconnecting the input terminals between the sets thereof,

wherein the output lines, the output terminals and the input lines are formed on a semiconductor device mounting surface of each of the circuit boards, on which the semiconductor device is mounted, and the input bus lines are constituted by the two sets of the input lines connected to one another through the semiconductor device,

wherein each of the circuit board is mounted in the liquid crystal display by connecting the output terminals thereof to electrode terminals of the liquid crystal display, and

wherein each of the circuit boards is connected to an adjoining one of the circuit boards by electrically connecting each set of the input terminals with a set of the input terminals of the adjoining one of the circuit boards.

35. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

at least a circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines, a set of output terminals connected to the output lines and at least a set of input lines correspondingly to each of the semiconductor devices and also has at least a set of input terminals connected to the set of the input lines, respectively, and input bus lines connected to the input terminals,

wherein the output lines, the output terminals and the input lines are formed on a semiconductor device mounting surface of the circuit board, on which the semiconductor devices are mounted, and the input terminals and the input bus lines are formed on an opposite surface of the circuit board, and the input bus lines of the circuit board are connected to the input terminals or the input lines through a via hole, and

wherein the circuit board is mounted in the liquid crystal display by connecting the output terminals to electrode terminals of the liquid crystal display.

36. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

at least a circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines and a set of output terminals connected to the output lines correspondingly to each of the semiconductor devices, and also has at least a set of input terminals connected to the sets of the input lines, respectively, and input bus lines connected to the input terminals,

wherein the input lines, the input terminals and the output lines are formed on a semiconductor device mounting surface of each of the circuit boards, on which the semiconductor devices are mounted, and the output terminals are formed on a surface opposite to the semiconductor device mounting surface of the circuit board, and each of the output terminals is bonded to corresponding one of the output terminals through a via hole, and the input bus lines are constituted by the input lines connected to one another through the semiconductor devices, and

wherein the circuit board is mounted in the liquid crystal display by connecting the output terminals to electrode terminals of the liquid crystal display.

37. A liquid crystal display on which a plurality of liquid crystal driving semiconductor devices are mounted, the liquid crystal display comprising:

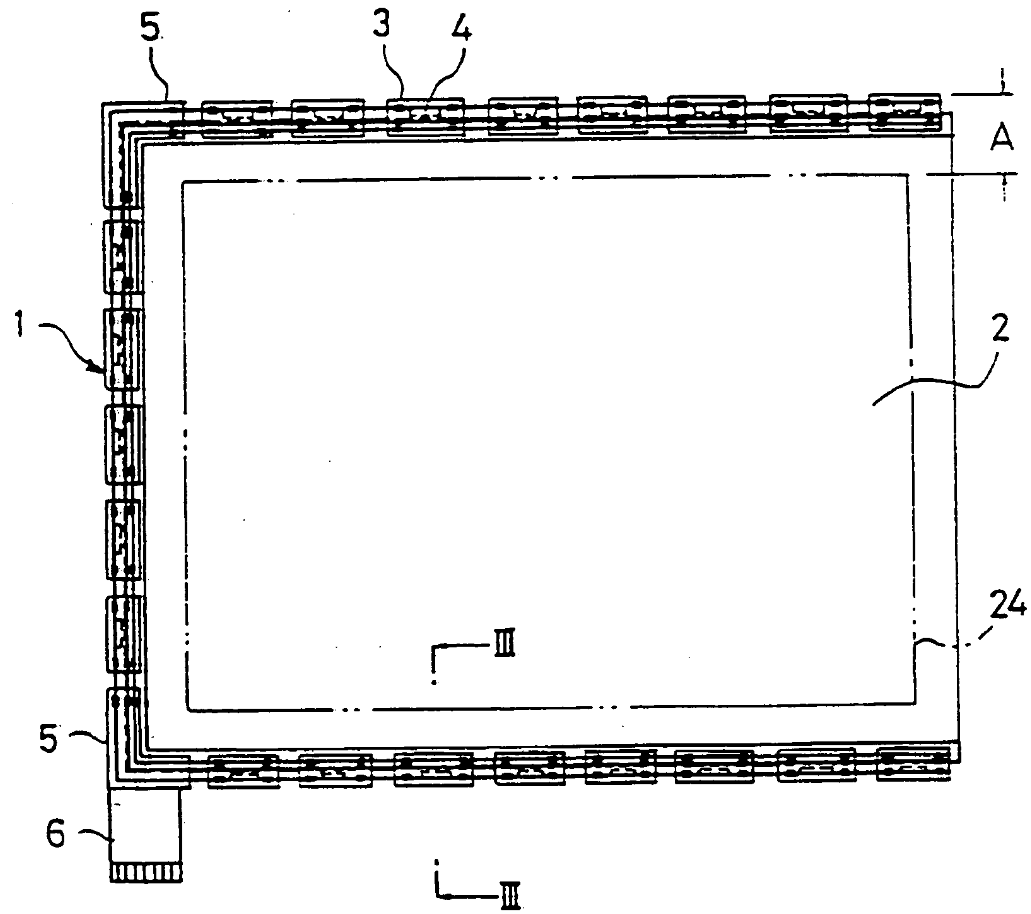
at least a circuit board, on which a plurality of semiconductor devices are mounted,

wherein the circuit board has a set of output lines, a set of output terminals connected to the output lines and a set of input lines correspondingly to each of the semiconductor devices, and also has at least a set of input terminals connected to the set of the input lines, respectively, and input bus lines connected to the input terminals,

wherein the input lines, the input terminals and the output lines are formed on a semiconductor device mounting surface of the circuit boards, on which the semiconductor devices are mounted, and the input terminals and the input bus lines are constituted by the input lines connected to one another through the semiconductor devices, and

wherein the circuit board is mounted in the liquid crystal display by connecting the output terminals to electrode terminals of the liquid crystal display.

Fig. 1



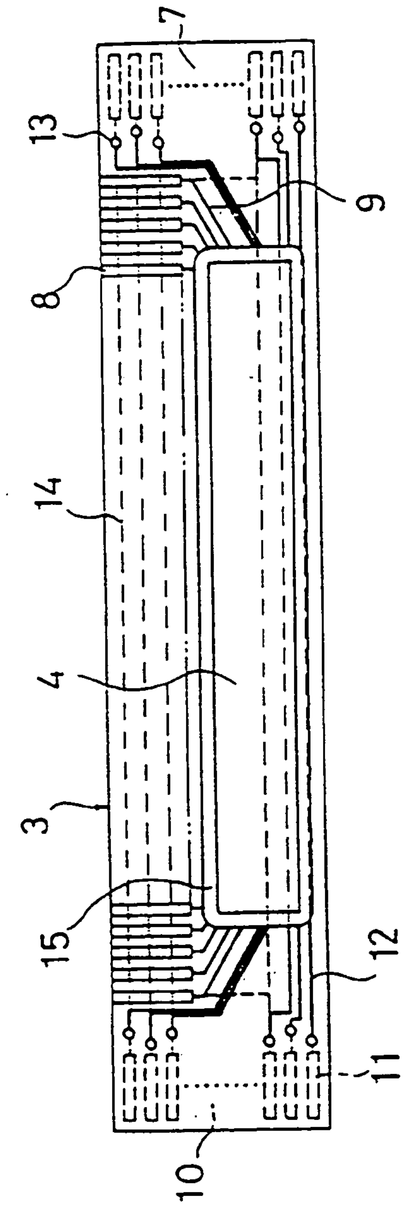
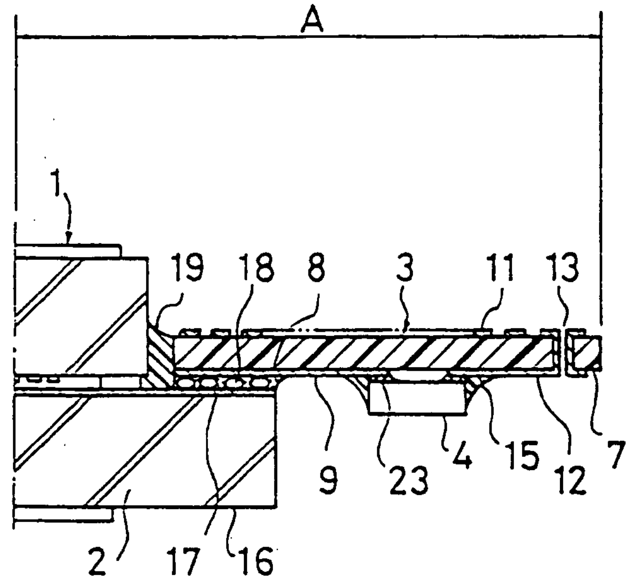


Fig. 2

Fig. 3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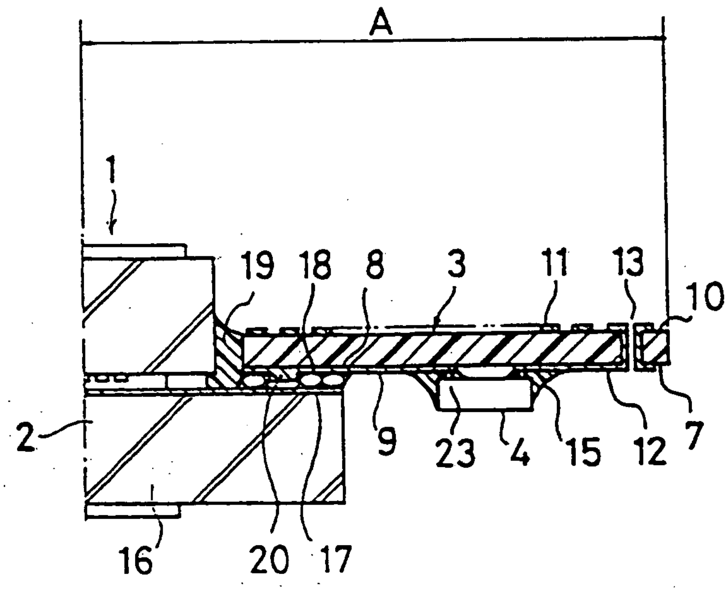
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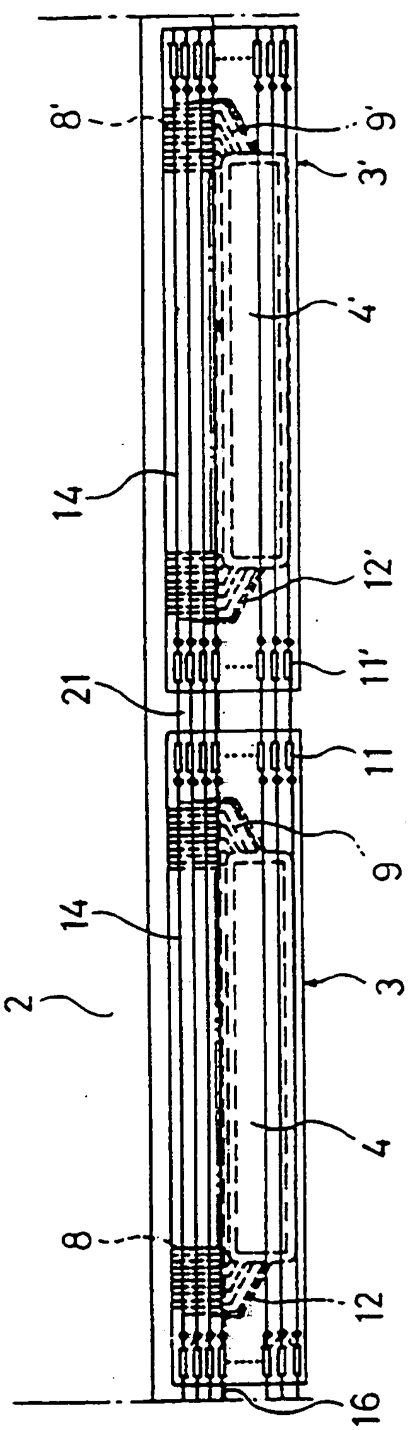
Fig. 5



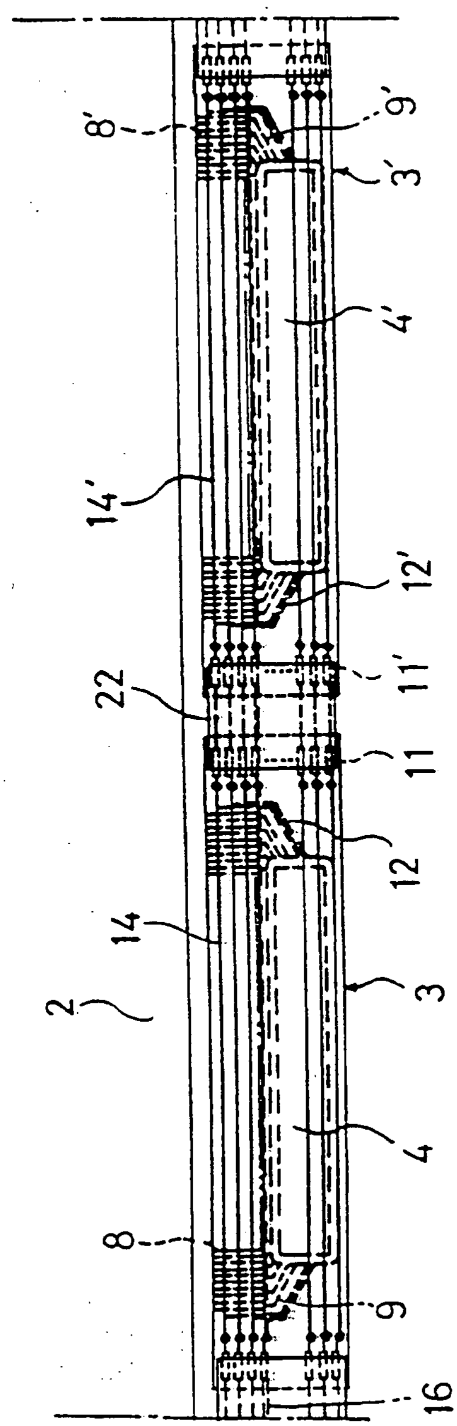


Fig. 6

Fig. 7

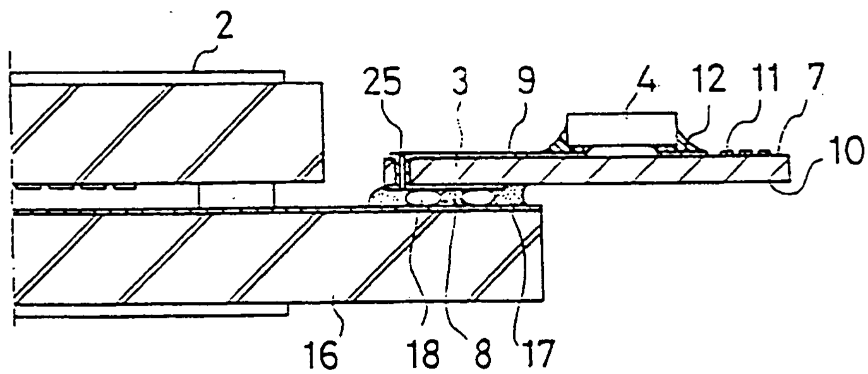
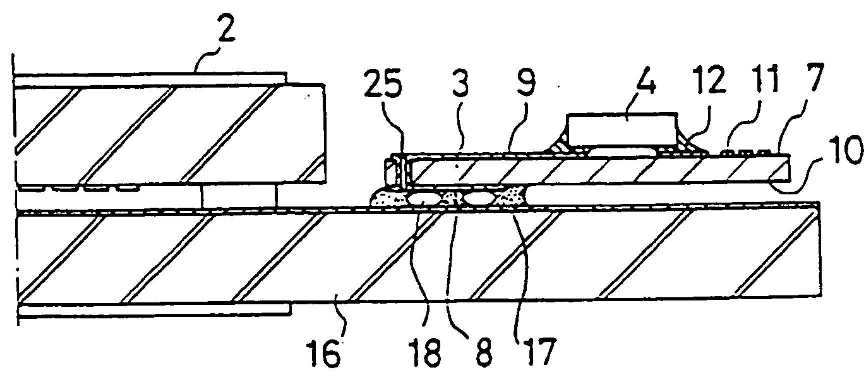


Fig. 8



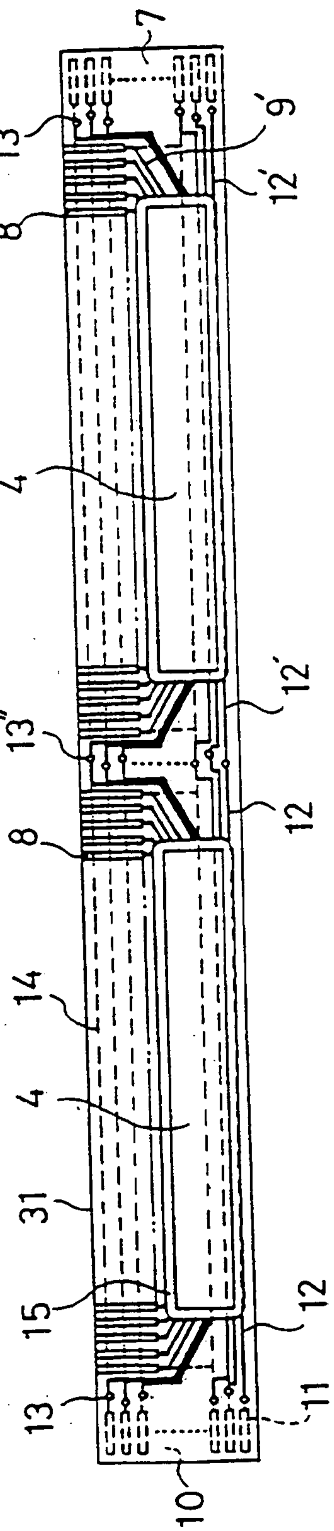
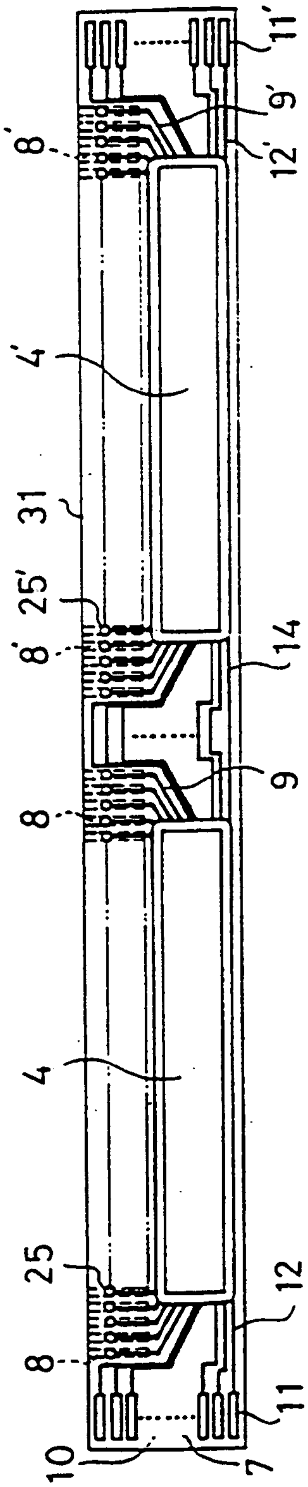


Fig. 9

Fig. 10



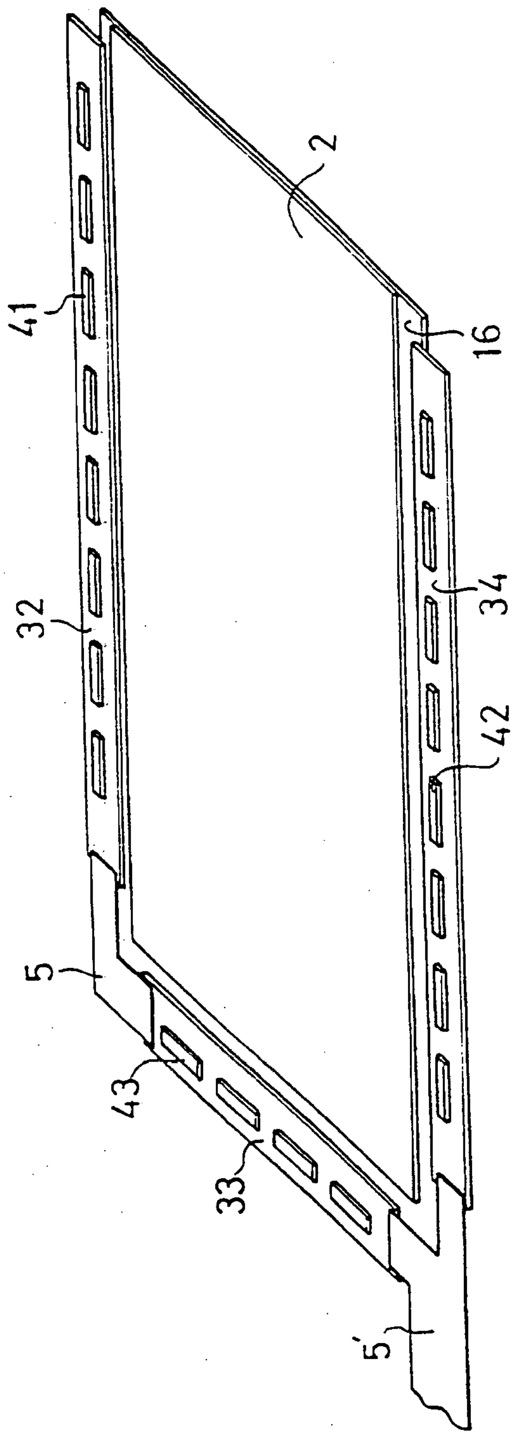


Fig. 11

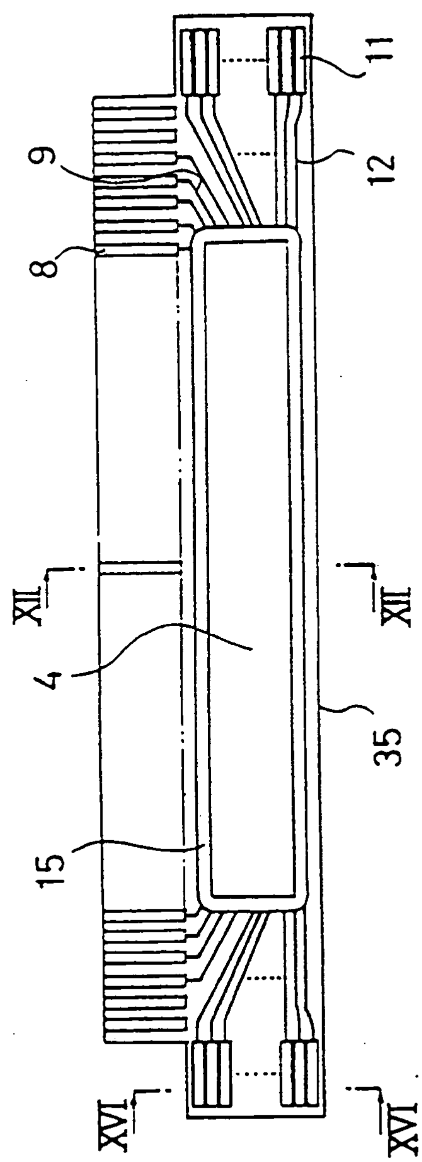


Fig. 12

Fig. 13

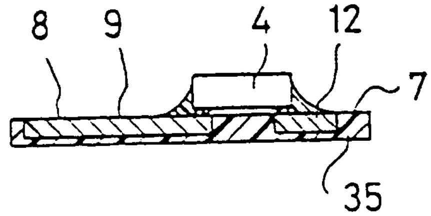


Fig. 14

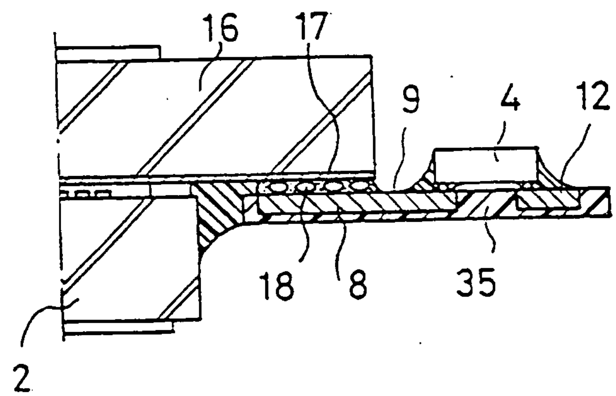


Fig. 15

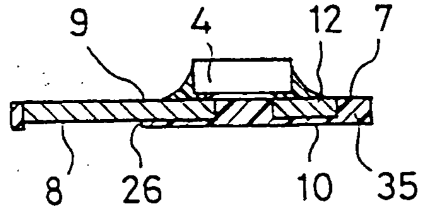


Fig. 16

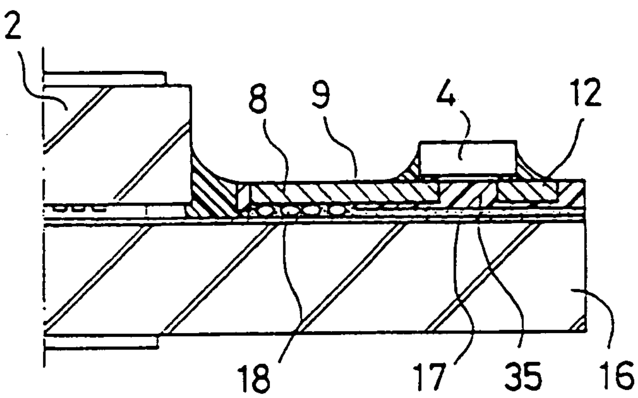


Fig. 17

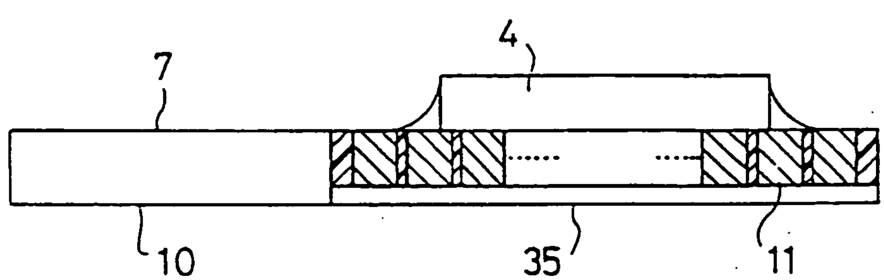


Fig. 18

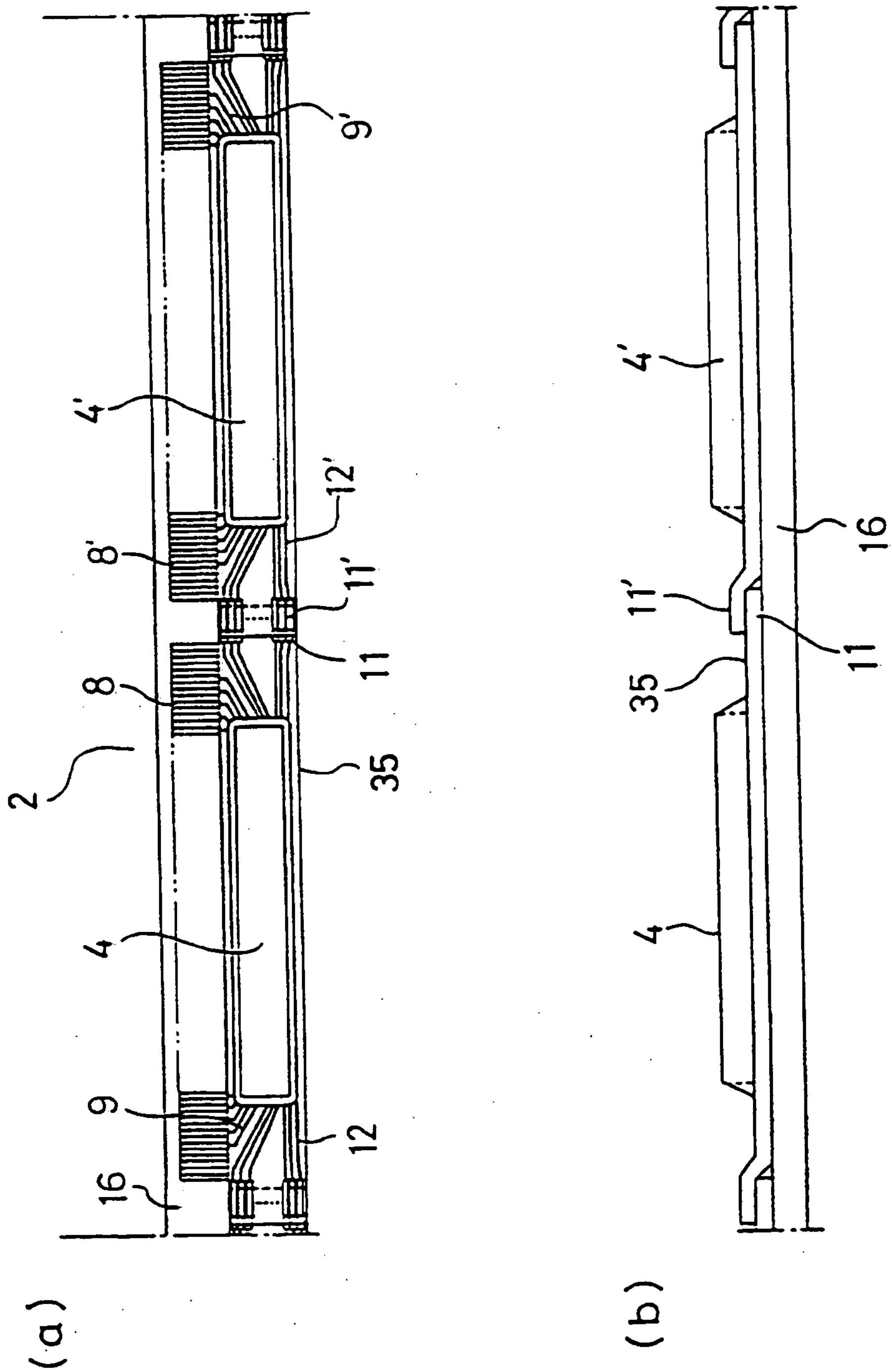


Fig. 19

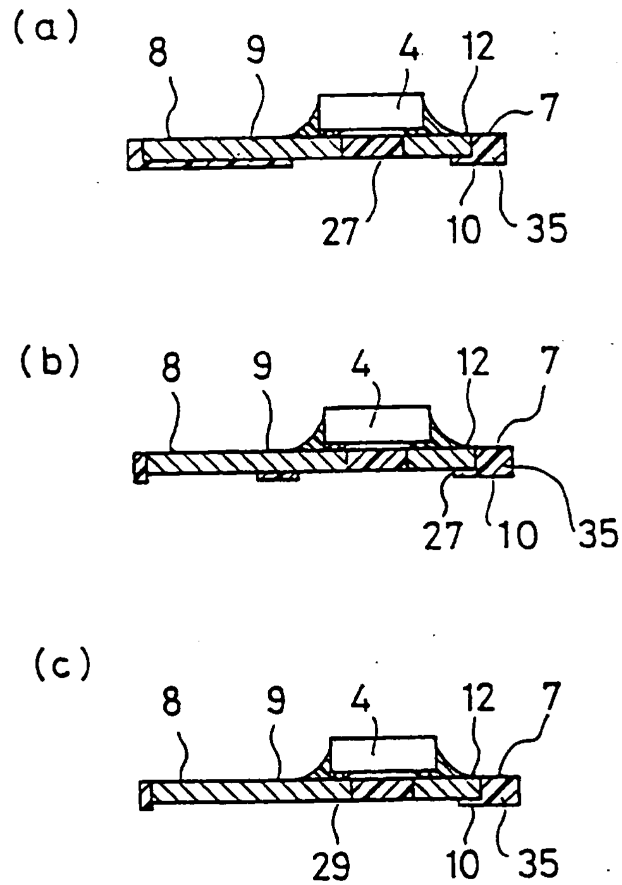


Fig. 20

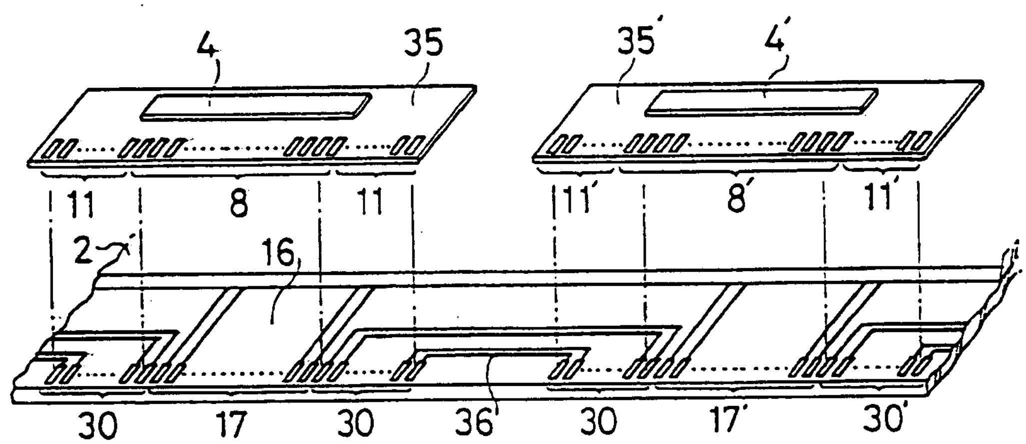

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Fig. 21

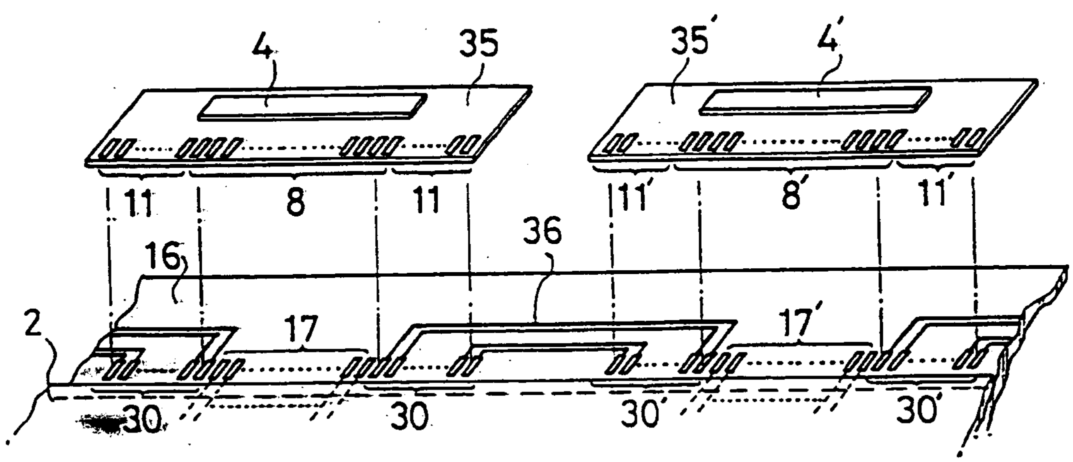
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Fig. 22

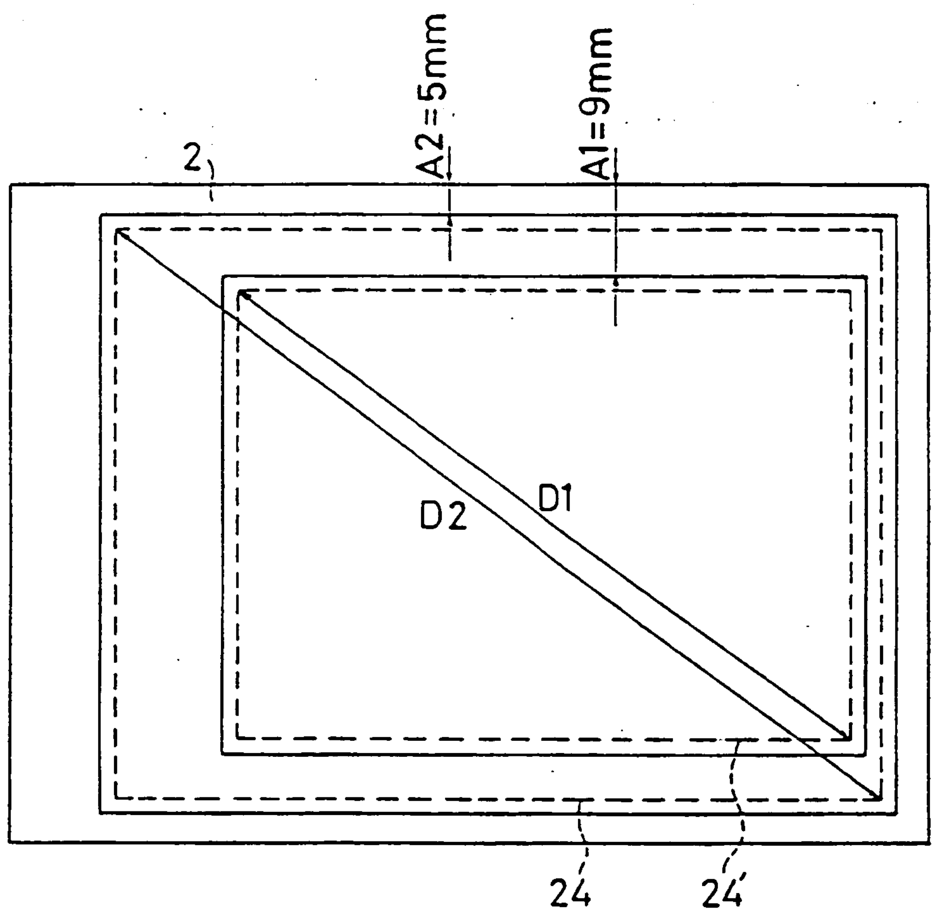


Fig. 23

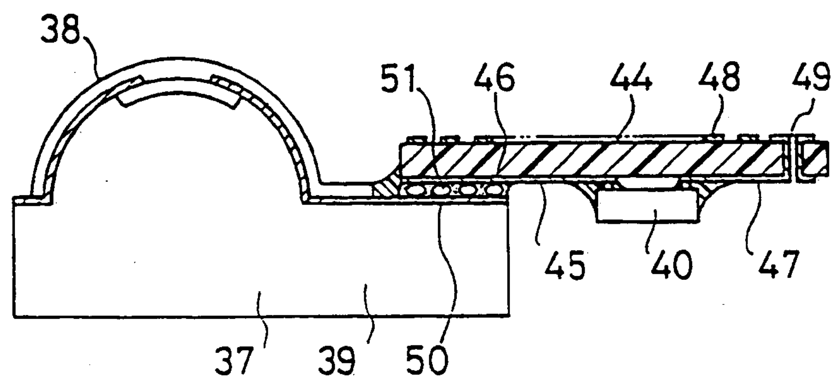


Fig. 24

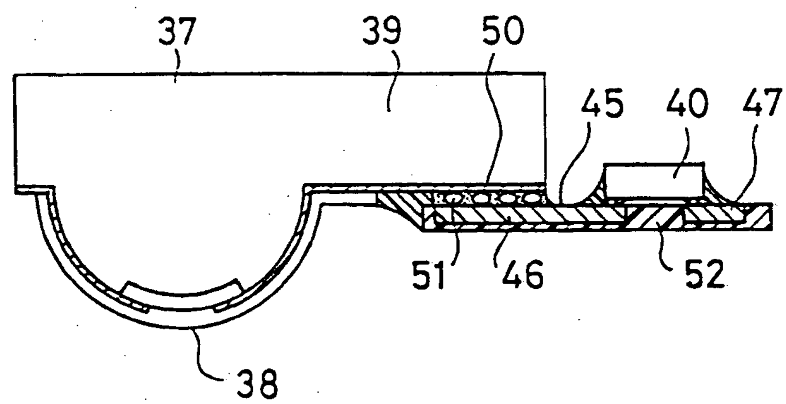


Fig. 25

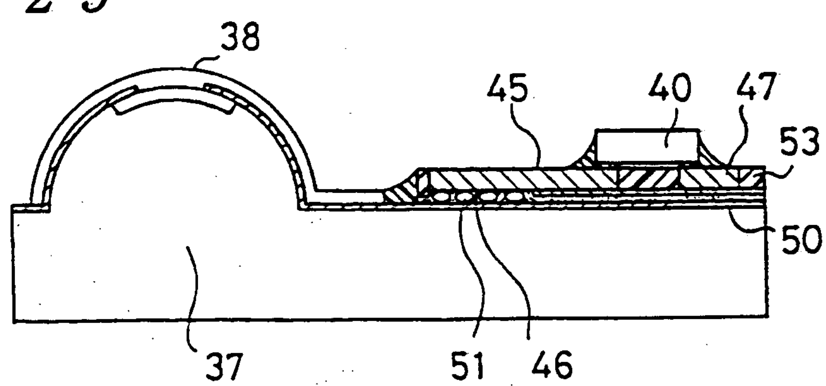


Fig. 26

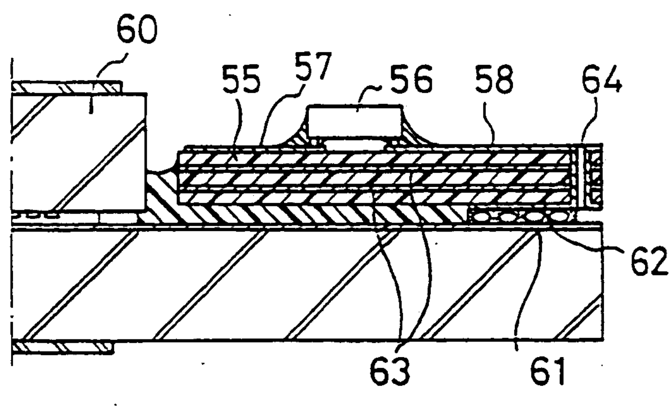
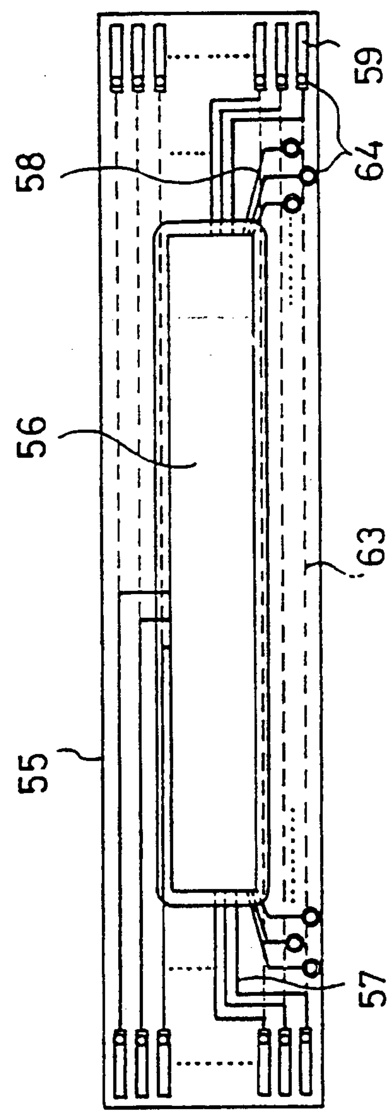


Fig. 27



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/01887

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 H01L21/60, G02F1/1345

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 H01L21/60, G02F1/1345

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1962 - 1994
Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP, A, 4-147221 (Casio Computer Co., Ltd.), May 20, 1992 (20. 05. 92), (Family: none)	9, 14, 15, 20, 21, 27-31, 34, 37
A	JP, A, 4-274413 (Hitachi, Ltd.), September 30, 1992 (30. 09. 92), (Family: none)	1-8, 10-13 22-26, 32, 33
A	JP, A, 4-212495 (Micro Gijutsu Kenkyusho K.K.), August 4, 1992 (04. 08. 92), (Family: none)	16-19, 35, 36

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
January 11, 1995 (11. 01. 95)	January 31, 1995 (31. 01. 95)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.